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Synopsis of Biological Data on the Spottail Pinfish, *Diplodus holbrooki* (Pisces: Sparidae)

January 1985

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George H. Darcy

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Synopsis of Biological Data on the Spottail Pinfish, *Diplodus holbrooki* (Pisces: Sparidae)

GEORGE H. DARCY[1]

ABSTRACT

Information on the biology and fishery resources of the spottail pinfish, *Diplodus holbrooki*, is compiled, reviewed, and analyzed in the FAO species synopsis style.

INTRODUCTION

The spottail pinfish, *Diplodus holbrooki*, is a common, shallow-water sparid fish occurring along the southern Atlantic and Gulf of Mexico coasts of the United States. Individuals are especially common along the Carolinas and on the west coast of Florida. They are sometimes quite abundant on grassflats and may be among the dominant fish species on natural and artificial reefs, man-made platforms, and jetties. Because of their abundance, spottail pinfish may be ecologically important as forage for larger carnivores; they are among the dominant herbivores in shallow-water grassbeds. Their flesh is of excellent quality, and spottail pinfish probably make up a significant portion of the catch of subsistence fishermen through much of their range. There is no known directed fishery. This paper summarizes information on this species.

1 IDENTITY

1.1 Nomenclature

1.11 Valid name

Diplodus holbrooki (Bean 1878) (Fig. 1). Also appears as *Diplodus holbrookii* (Bean 1878), bearing the original patronym emendation of Bean (e.g., Randall and Vergara R. 1978).

Spottail pinfish, *Diplodus holbrooki* (Bean 1878:198), type locality: Charleston, S.C. The name comes from the Greek *diploos*, meaning double, and *odontos*, meaning tooth, referring to the two types of teeth. Named after John Edwards Holbrook, naturalist and author of "Ichthyology of South Carolina" (Jordan and Fesler 1893).

1.12 Objective synonymy

The following synonymy is based on Jordon and Fesler (1893) and Hildebrand and Schroeder (1928):

Sargus holbrookii Bean 1878
Diplodus holbrooki. Jordan and Gilbert 1882
Diplodus caudimacula. Jordan and Gilbert 1883 (young, not *caudimacula* of Poey)
Diplodus holbrookii. Bean 1891

1.2 Taxonomy

1.21 Affinities

Suprageneric

Phylum Chordata
Class Osteichthyes
Superorder Acanthopterygii
Order Perciformes
Suborder Percoidei
Family Sparidae

Generic

The genus *Diplodus* Rafinesque, Indice d'Ittilogia Siciliana 54, 1810, is best represented in the eastern Atlantic Ocean (Jordan and Fesler 1893), though at least three species occur in the western Atlantic (Randall and Vergara R. 1978). Type of the genus is *Sparus annularis* Gmelin (Jordan and Fesler 1893).

Members of the genus are characterized by an ovate, compressed body with the back notably elevated; broad, strongly flattened, unnotched, incisiform jaw teeth at the front of the mouth; molariform teeth in several rows; a large, dark blotch on the caudal peduncle; short gill rakers; about 12 dorsal fin spines; and the absence of a procumbent (forward-pointing) spine preceding the dorsal fin (Hildebrand and Schroeder 1928; Randall and Vergara R. 1978). The skull resembles that of *Archosargus*, but the cavernous or honeycombed structure of the interorbital area is more prominent (Jordan and Fesler 1893).

Specific

The following species diagnosis is based on Randall and Vergara R. (1978): Body oval, compressed, and very deep, the body depth contained about 2.2 times in standard length (SL); snout pointed, lateral profile nearly straight; posterior nostril rounded; mouth moderately developed, maxilla barely reaching to anterior eye margin; both jaws anteriorly with 6 well developed incisiform teeth; 3 rows of lateral molariform teeth; 17-21 gill rakers on first arch; dorsal fin XII, 13-16, not preceded by a small

[1]Southeast Fisheries Center, National Marine Fisheries Service, NOAA, 75 Virginia Beach Drive, Miami, FL 33149-1099.

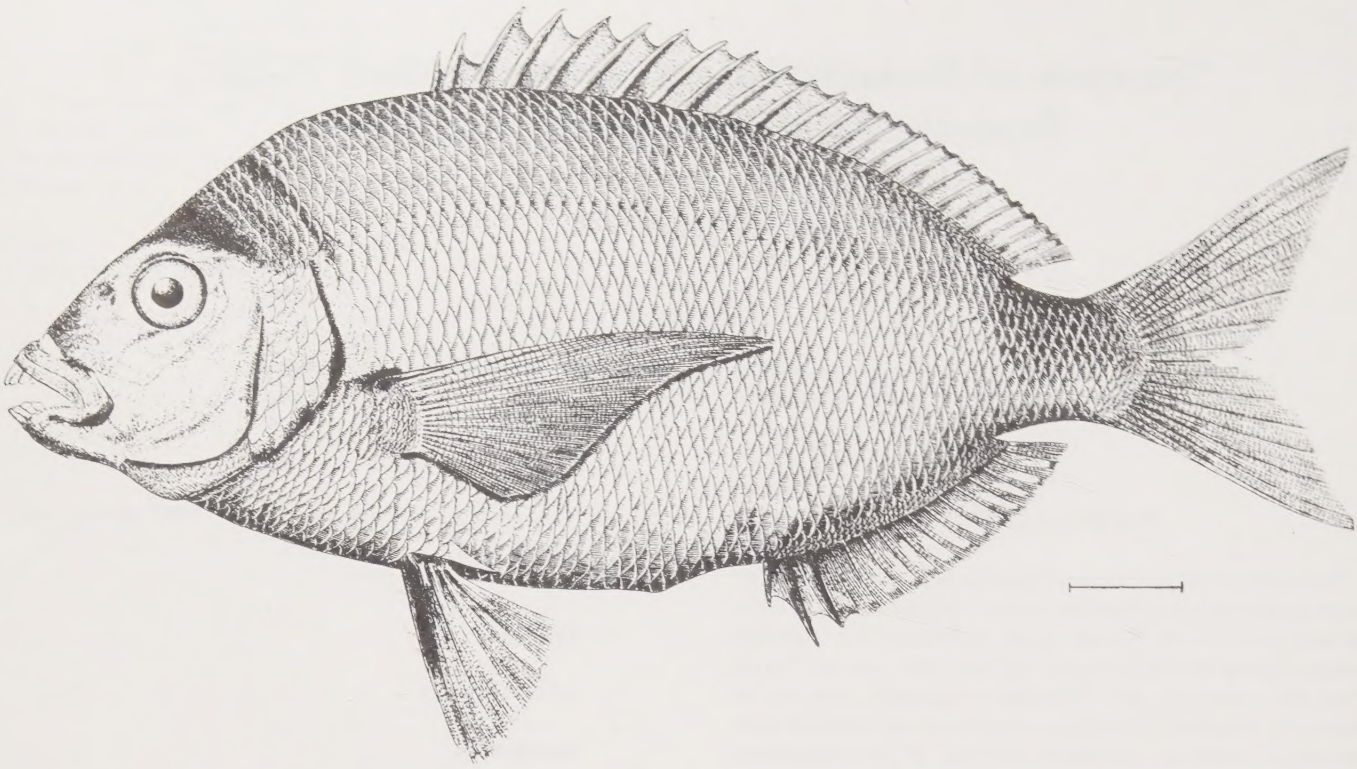

Figure 1.—Adult *Diplodus holbrooki*. (From Goode 1884, plate 132.)

forward-directed spine; longest dorsal spine about 2.5 times in head length; anal fin with 13-15 soft rays; pectoral fins long, reaching at least to first anal spine when appressed; lateral line scales 50-61. Steel blue color on back, sides silvery, with a large black spot anteriorly on caudal peduncle which nearly reaches lower peduncular margin; opercular membrane blackish.

Two other species of *Diplodus* occur in the western Atlantic Ocean—*D. argenteus* and *D. bermudensis*. *Diplodus holbrooki* differs from *D. argenteus* (*D. argenteus caudimacula* of Randall and Vergara R. 1978) in having lower dorsal and anal fins, a shallower body, fewer lateral lines scales (50-61 vs. 56-65), and a larger caudal peduncle spot (extending well below midline in *D. holbrooki*, only slightly below in *D. argenteus*) (Randall and Vergara R. 1978). *Diplodus bermudensis* has even more lateral line scales (62-67) and is known only from Bermuda, where *D. holbrooki* has not been reported (Randall and Vergara R. 1978).

1.22 Taxonomic status

Diplodus holbrooki is a morphospecies.

1.23 Subspecies

No subspecies are recognized.

1.24 Standard common names, vernacular names

The accepted common name of *D. holbrooki* in the United States is spottail pinfish (Robins et al. 1980), and standard FAO common names are: English, spottail pinfish; French, sar cotonnier; Spanish, sargo cotonero (Randall and Vergara R. 1978). Other names and variations appearing in the literature include: Charleston bream, pin-fish (Goode 1884); jimmy (Goode and Gill 1903); spot, pinfish (Jordan and Evermann 1923); spot-tailed pinfish, sailor's choice (Hildebrand and Schroeder 1928); spot-tail pinfish (Reid 1954); and spot tail (Springer and Woodburn 1960).

1.3 Morphology

1.31 External morphology

The following morphological description is based on Jordan and Fesler (1893), Hildebrand and Schroeder (1928), Miller and Jorgenson (1973), Hoese and Moore (1977), and Randall and Vergara R. (1978).

Body elliptical, compressed, and deep (depth about 2.1-2.2 in SL). Dorsal profile regularly rounded; snout pointed, with nearly straight profile. Head 3.25-3.65 in SL. Eye rather small, 1.75 in preorbital distance, 1.50 in snout, 4.35-4.50 in head. Mouth moderate to large, almost horizontal; maxillary 3.35 in head and not quite reaching anterior margin of eye. Six well developed incisiform teeth at front of each jaw, inserted obliquely; 3 rows of molariform teeth laterally. Posterior nostril rounded. Gill rakers short, about 17-21 on first arch. Dorsal fin XII-XIII, 13-16, not preceded by a procumbent spine; fin continuous; longest dorsal spine about 2.5-2.7 in head. Caudal fin deeply forked; total caudal rays 33-34 (dorsal primary rays 9, dorsal secondary rays 8-9, ventral primary rays 8, ventral secondary rays 7-10). Anal fin III, 12-15, the second spine slightly longer than the third. Pelvic fins reaching half way to anal fin origin. Pectoral fins long, pointed, reaching at least to first anal fin spine when appressed, 3.35 in body. Lateral line scales 50-61; 7 scales above and 14 scales below lateral line. Precaudal vertebrae 10-11, caudal vertebrae 14.

Mouth and tooth morphology has been described in detail by Stoner and Livingston (1984).

Steel blue color on back, silver on sides; conspicuous black spot anteriorly on caudal peduncle, nearly reaching lower peduncular margin; opercular membrane and bases of pectoral fins blackish. Young have about 5 narrow, vertical, dark bars on back and sides, with an equal number of short intermediate bars on the back.

2 DISTRIBUTION

2.1 Total area

The spottail pinfish is distributed in coastal waters of the United States from New Jersey south to Florida on the Atlantic coast, and from Florida to southern Texas on the Gulf of Mexico coast (Fig. 2). It is apparently absent from Bermuda, the Bahamas, and the West Indies (Jordan and Fesler 1893; Smith 1976; Randall and Vergara R. 1978).

Although one 56 mm TL specimen was collected by seine in Absecon Inlet, NJ, in 1974 (Milstein and Thomas 1976), and the species has been collected in Chesapeake Bay (Hildebrand and Schroeder 1928), spottail pinfish are much more common south of Cape Hatteras (Hildebrand and Schroeder 1928; Struhsaker 1969; Smith 1976). Specimens from north of Cape Hatteras probably result from Gulf Stream drift and do not represent local populations. In the Gulf of Mexico, several workers have placed the north end of the range near Cedar Key, FL (e.g., Hildebrand and Schroeder 1928; Randall and Vergara R. 1978). However, reports of spottail pinfish from the northern (Hastings 1972; Hastings et al. 1976) and northwestern Gulf (Briggs et al. 1964; Causey 1969; Hastings 1972) have established its presence at least as far south and west as southern Texas. In the northwestern Gulf, spottail pinfish appear to inhabit relatively deep water, farther offshore, than in the northeastern Gulf (Hastings 1972).

See 2.21, 2.22, 2.3, and 4.2.

2.2 Differential distribution

2.21 Spawn, larvae, and juveniles

Distribution of eggs is not known. Spawning probably takes place somewhat offshore, yet in fairly shallow water. The scarcity of spottail pinfish north of Virginia indicates that spawning probably does not take place much north of Cape Hatteras, NC.

Larval spottail pinfish were collected by Houde et al.[2] during ichthyoplankton surveys of the northeastern Gulf of Mexico (Fig. 3). Larvae were collected on only 2 out of 17 cruises in January-March. All were taken in < 15 m of water (4-15 m). Environmental conditions at the time of collection ranged from 16° to 18°C and from 34 to 35‰ salinity.

Juveniles are usually found in shallow water. Individuals as small as 7 mm SL have been found near shore (Hastings 1972). Smallest juveniles usually appear inshore in spring or early summer (Caldwell 1955; Springer and Woodburn 1960; Hastings 1972), occupying shallow seagrass flats (Caldwell 1955), eelgrass beds (Darnell and Wissing 1975), wharf pilings (Jordan and Evermann 1923), and areas of sparse vegetation on sandy-mud bottom (Reid 1954). Caldwell (1955) found age-0 spottail pinfish most abundant on shallow flats near Cedar Key, FL, in spring and summer, moving to deeper flats and channel edges in fall and early winter; age-0 fish disappeared entirely from inshore waters in winter. A similar distribution of juveniles was noted by Reid (1954), with 56-90 mm SL individuals found on deep flats in fall. Larger fish (> 91 mm SL) are most common at deeper offshore

[2]Houde, E. D., J. C. Leak, C. E. Dowd, S. A. Berkeley, and W. J. Richards. 1979. Ichthyoplankton abundance and diversity in the eastern Gulf of Mexico. Report to Bureau of Land Management under Contract No. AA550-CT7-28, 546 p.

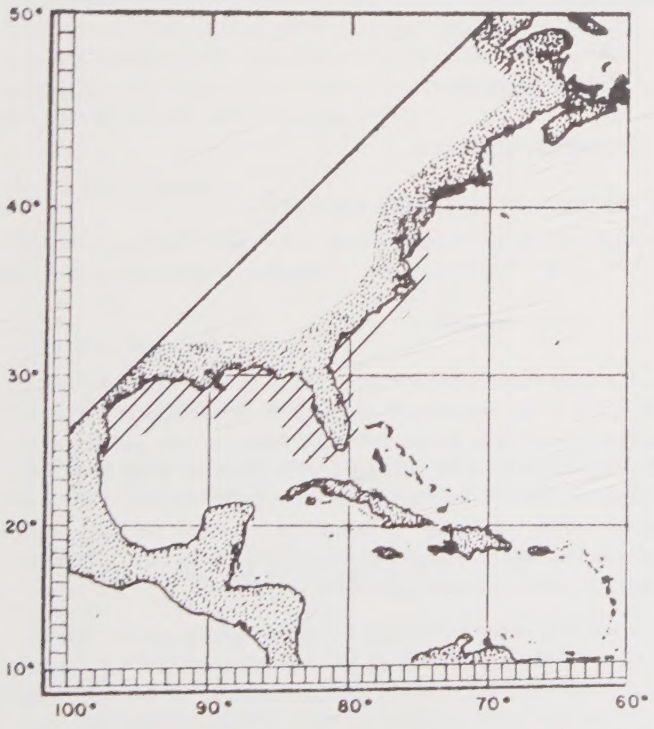

Figure 2.—Distribution of *Diplodus holbrooki*. (Based on Milstein and Thomas 1976; Smith 1976; Hoese and Moore 1977; Randall and Vergara R. 1978.)

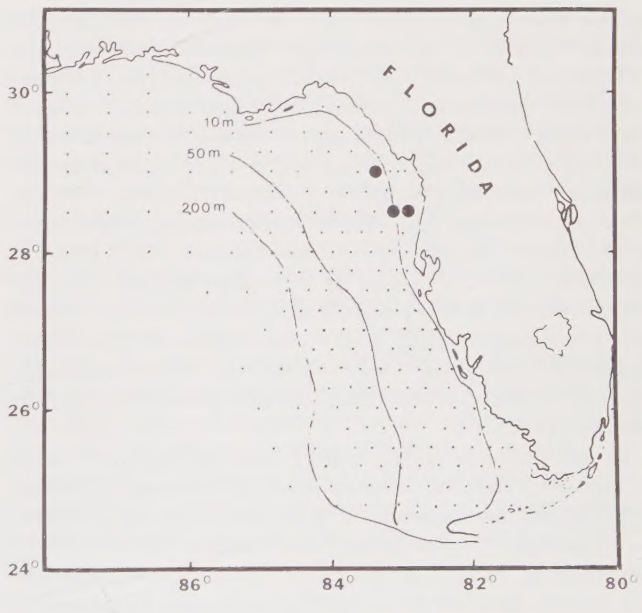

Figure 3.—Stations at which *Diplodus holbrooki* larvae were collected at least once during 17 cruises to the eastern Gulf of Mexico, 1971-74 (large dots). Small dots are stations that were sampled but did not produce *D. holbrooki* larvae. (From Houde et al. see text footnote 2, fig. 112.)

stations, but sometimes occur inshore on shallow flats or on channel edges (Caldwell 1955).

See 2.3 and 4.2.

2.22 Adults

Adult spottail pinfish usually inhabit deeper water than juveniles (Caldwell 1955; Hastings 1972), though they also occur inshore. Offshore habitats include natural and artificial reefs (Causey 1969; Parker et al. 1979; Smith et al. 1979; Miller and Richards 1980), live bottom (Struhsaker 1969), sponge reefs (Stoner and Livingston 1984), man-made platforms (Hastings et al. 1976), and open, sandy bottom near rock reefs or other relief (Springer and Woodburn 1960). A study in the northern Gulf of Mexico by Smith et al. (1979) showed spottail pinfish more abundant around artificial reefs than natural reefs. Adults, like juveniles, apparently leave nearshore habitats for deeper water in winter (Caldwell 1955). Springer and Woodburn (1960) observed a number of large specimens in 10.7 m of water, 19 km offshore from Tampa, FL, in February.

Inshore, adults occur on flats and channel edges (Caldwell 1955), near jetties, breakwaters, and piers (Hildebrand and Schroeder 1928; Hastings 1972), and in bays and harbors (Springer and Woodburn 1960; Randall and Vergara R. 1978) of fairly high salinity.

See 2.3 and 4.2.

2.3 Determinants of distribution changes

Distribution of spottail pinfish is affected by water temperature (season), salinity, water depth, and availability of suitable substrate and habitat. The influence of these environmental factors changes with growth stage of the fish.

The geographical range of spottail pinfish is probably determined by suitable temperatures; the species is considered warm-temperate and exhibits a typical Carolinian distribution (Smith 1976). Seasonal inshore-offshore movements are probably in response to temperature changes. Typically, small young appear in shallow water in spring when waters are warming, and remain in shallow water over flats in summer (Caldwell 1955; Hastings 1972; Stoner and Livingston 1984). In late summer and fall, spottail pinfish often move to slightly deeper flats and channel edges (Reid 1954; Caldwell 1955; Wang and Raney 1971), possibly to avoid warm surface waters. In late fall or winter, spottail pinfish disappear from shallow water, presumably moving offshore (Caldwell 1955; Hastings 1972). Reid (1954) collected specimens at 15.5-24.5°C at Cedar Key, FL, and Caldwell (1955) reported them from 17.5-32.5°C water. In St. Andrew Bay, FL, Hastings (1972) observed spottail pinfish in shallow water at 16-31°C surface temperature. During 1 yr of Hastings' study, individuals disappeared from shallow water by the time water temperature fell to 17°C; during another year they were present at 16°C, but absent at 14°C.

Spottail pinfish are usually found at fairly high salinities, rarely in brackish water, and virtually never in freshwater (Caldwell 1955; Randall and Vergara R. 1978; Stoner and Livingston 1984). At Cedar Key, FL, specimens were collected at 9.7-31.0‰ salinity (Reid 1954; Caldwell 1955), though Caldwell reported that salinity rarely fell below 24.0‰ in the areas frequented by spottail pinfish. Wang and Raney (1971) found spottail pinfish only in the outer bay system of Charlotte Harbor, FL, just inside the barrier islands where salinities are relatively high. One specimen was reported from Salt Spring, Hernando Co., FL, about 1.4 km inland from the mouth of the Mud River (Kilby, pers. commun. in Caldwell 1955). Salinity at the time of the observation is unknown, but may have been quite low. This observation apparently represents a rare occurrence in this type of habitat.

Although basically shallow-water fish, spottail pinfish do range offshore (Chester et al. 1984). Young are typically found in shallow water, with larger individuals more common in deeper water (Caldwell 1955; Hastings 1972; Randall and Vergara R. 1978). The deepest record known is about 82 m (R. O. Parker[3]). Smith et al. (1979) reported that spottail pinfish around offshore man-made platforms in the northern Gulf of Mexico are found primarily in the upper water column around pilings. In the northwestern Gulf, spottail pinfish are seldom found inshore in shallow water, but do occur on reefs offshore (Hastings 1972). Causey (1969) reported spottail pinfish as residents of Seven and One-Half Fathom Reef, off Padre Island, TX.

Availability of suitable habitat also affects distribution of spottail pinfish. Inshore, flat, vegetated bottoms such as grassflats are preferred (Caldwell 1955; Randall and Vergara R. 1978; Stoner and Livingston 1984). Grassbeds also act as nursery areas (Hastings 1972), and may provide shelter and food. Smith (1976) listed spottail pinfish as a secondary reef species. Longley and Hildebrand (1941) occasionally found them near coral on reefs, but spottail pinfish are apparently more common around rock reefs, sponge reefs, artificial reefs, jetties, and man-made platforms (Springer and Woodburn 1960; Hastings 1972; Hastings et al. 1976; Smith et al. 1979; Parker et al. 1979; Stoner and Livingston 1984) than on true coral reefs. Miller and Richards (1980) listed the species as a reef fish in the South Atlantic Bight. Smith (1976) did not list spottail pinfish from the Florida Middle Grounds. They are common on live bottom in the South Atlantic Bight (Struhsaker 1969) and the northeastern Gulf of Mexico (Darcy and Gutherz 1984), but apparently are not residents of the soft-bottom communities of the white shrimp and brown shrimp grounds of the northwestern Gulf of Mexico (Chittenden and McEachran 1976).

See 2.22, 3.32, and 3.51.

2.4 Hybridization

No hybrids are known.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.11 Sexuality

No information concerning sexuality in spottail pinfish could be found in the literature. Many porgies are protandric hermaphrodites (Breder and Rosen 1966). *Diplodus vulgaris* and *D. annularis* of the eastern Atlantic have been reported to be hermaphroditic, at least on some occasions (Holt 1899; Stéphan 1902; van Oordt 1930). *Diplodus annularis* is reported to have both monoecious and dioecious individuals (van Oordt 1930). Whether spottail pinfish are hermaphroditic is unknown.

[3]R. O. Parker, Fishery Biologist (Research), Southeast Fisheries Center Beaufort Laboratory, National Marine Fisheries Service, NOAA, Beaufort, NC 28516-9722, pers. commun.

3.12 Maturity

Spottail pinfish appear to spawn during the second winter or spring after hatching (Reid 1954). Reid found a 90 mm SL specimen with developed, but not mature gonads. No fish smaller than 129 mm SL was found to have spawned, but 129-153 mm SL individuals showed considerable gonad development in the prespawning season.

3.13 Mating

Mating has not been reported in the literature. Pairing may take place, and hermaphroditism is possible (Breder and Rosen 1966).

3.14 Fertilization

Fertilization is probably external.

3.16 Spawning

Spottail pinfish appear to spawn in winter or early spring based on occurrence of larvae and small juveniles. Ichthyoplankton surveys conducted in the eastern Gulf of Mexico by Houde et al. (footnote 2) produced spottail pinfish larvae only in winter (January-March). Smallest juveniles (29-39 mm SL) collected by Reid (1954) at Cedar Key, FL, were collected in May. Caldwell (1955) found 17 mm SL individuals inshore at Cedar Key in late March and speculated that they were probably spawned in late December through February. Stoner and Livingston (1984) reported smallest juveniles (11 mm SL) from Apalachee Bay, FL, in March. In Tampa Bay, FL, Springer and Woodburn (1960) collected 19 mm juveniles in April. Hastings (1972) reported that small juveniles (14.4-16.9 mm SL) were collected by S. A. Bortone near St. Andrew Bay, FL, jetties in May, indicating a March-April spawning period.

Spawning is assumed to take place offshore, since large individuals are absent from shallow water during the spawning season (Caldwell 1955). Spawning probably occurs only once during the year, and lasts for only about 2 mo, based on occurrence of juveniles (Caldwell 1955; Hastings 1972).

3.17 Spawn

Eggs of spottail pinfish have not been described in the literature, but are probably planktonic.

3.2 Preadult phase

3.21 Embryonic phase

Although there is no information regarding the embryo of spottail pinfish, the developing eggs are probably planktonic.

3.22 Larvae and adolescent phase

Larvae have not been described in the literature. Specimens collected in ichthyoplankton surveys by Houde et al. (footnote 2) ranged from 2.1 to 9.0 mm SL, with a mode of 4.1-5.0 mm.

Juveniles have about five narrow, vertical, dark bars on the sides of the body (Hildebrand and Schroeder 1928).

See 1.3.

3.3 Adult phase

3.31 Longevity

According to Randall and Vergara R. (1978), spottail pinfish reach 32 cm SL, and are common to 25 cm. Hildebrand and Schroeder (1928) reported examining a specimen of about 35 cm. Maximum weight is approximately 1.2 kg.[4]

3.32 Hardiness

The spottail pinfish is a warm-temperate species. Individuals have been collected from water as cold as 15.5°C (Reid 1954; Cedar Key, FL). Hastings (1972) found spottail pinfish in St. Andrew Bay, FL, at 16°C, but found none at 14°C. Movement out of shallow water in winter is probably a mechanism for avoiding low water temperatures. Highest temperature at which spottail pinfish have been reported in the literature is 32.5°C (Caldwell 1955; Cedar Key, FL). Reid (1954) and Caldwell (1955) noted a shift to deeper flats in late summer and fall. This may be in response to high temperatures on shallow flats during this period.

Although Briggs (1958) listed the spottail pinfish as euryhaline, it is rarely reported from water of very low salinity. Reid (1954) collected specimens at 9.7-28.6$^0/_{00}$ salinity at Cedar Key, but Caldwell (1955) collected them at 24.4-31.0$^0/_{00}$ in the same area. According to Caldwell (1955), salinity rarely was much below 24$^0/_{00}$ in areas inhabited by spottail pinfish.

See 2.3.

3.33 Competitors

Common associates of spottail pinfish include sparids, haemulids, serranids, and kyphosids. Of grassbed fishes studied by Carr and Adams (1973) at Crystal River, FL, only three had herbivorous life stages: Spottail pinfish; pinfish, *Lagodon rhomboides*; and halfbeak, *Hyporhamphus unifasciatus*. Of these, spottail pinfish become herbivorous at an early stage and remain so as adults, pinfish become herbivorous at about the same stage of development as spottail pinfish but become carnivorous as adults, and halfbeaks feed as herbivores as adults, but feed at the surface (Carr and Adams 1973). Only juvenile pinfish seem likely to compete for food with spottail pinfish in the inshore grassbed habitat. Spottail pinfish have heavy incisor teeth like sheepshead, *Archosargus probatocephalus*, but are more characteristic of open waters, less often seen around bridges and pilings, and prefer warmer water than sheepshead (Hastings 1972).

Spottail pinfish are among the most common fishes on artificial reefs off Clearwater, FL (Smith et al. 1979). Other common species on the artificial reefs include white grunt, *Haemulon plumieri*; tomtate, *Haemulon aurolineatum*; and sand perch, *Diplectrum formosum*. Hastings et al. (1976) reported spottail pinfish around man-made offshore platforms near Panama City, FL. Other fishes feeding at the same level in the water column on the pilings were pinfish and Bermuda chub, *Kyphosus sectatrix*.

Chester et al. (1984) used principal component analysis to examine headboat catches off the Carolinas. Spottail pinfish catches were most closely correlated with catches of whitebone porgy,

[4]Tardiff, C., and C. S. Manooch III. Age, growth, and length-weight relationship of the spottail pinfish, *Diplodus holbrooki*, in the South Atlantic Bight. Unpubl. manuscr., 6 p. Southeast Fisheries Center Beaufort Laboratory, National Marine Fisheries Service, NOAA, Beaufort, NC 28516-9722.

Calamus leucosteus; secondary associations of spottail pinfish with white grunt and tomtate were also found.

See 3.42 and 4.6.

3.34 Predators

Predators of spottail pinfish probably include snappers and groupers (Tardiff and Manooch footnote 4), large porgies, snook, barracuda, seatrouts, and flatfishes.

3.4 Nutrition and growth

3.41 Feeding

Spottail pinfish feed mainly on attached plants and animals, using their incisorlike teeth to scrape or nip off the food material (Carr and Adams 1972). Hastings et al. (1976) observed them grazing sessile organisms near the surface around pilings of man-made platforms off Panama City, FL. Although spottail pinfish were reported to move up and down the pilings during feeding, most of their feeding was done near the surface. Spottail pinfish are visual feeders and are most active during daylight (Stoner and Livingston 1984). Young fish exhibit two daytime behaviors: A sedentary mode in which they rest near pilings, large sponges, and other structures and feed little, and a cruising mode in which they move among seagrass blades with almost continuous nibbling at seagrass surfaces (Stoner and Livingston 1984).

The alimentary tract is composed of a short esophagus, a thick-walled, but highly distendable stomach with internal convolutions, and a tubular intestine that runs about half way to the vent, makes one loop anteriorly to the base of the pylorus, and returns to the vent in one to three short convolutions (Stoner and Livingston 1984). Gut length increases from about 0.81 times SL at 15 mm SL to 1.35 times SL at 100 mm SL, then decreases to about 1.05 times SL in adult fish.

See 3.42.

3.42 Food

Food habits of spottail pinfish are fairly complex and involve ontogenetic changes in food selection. Carr and Adams (1972, 1973) studied food habits of spottail pinfish at Crystal River, FL, and delineated three major stages of feeding with growth (Fig. 4). Juveniles 11-25 mm SL were primarily planktivorous; mollusk veligers, copepods, tunicate tadpole larvae, mysids, and small shrimp accounted for 56-87% of food ingested. Juveniles 21-60 mm SL passed through a stage in which a portion of the diet was made up of ectoparasitic branchiurans (*Argulus* sp.) and scales from other fishes. This phase, in which the juveniles cleaned ectoparasites from the bodies of other fishes, was most pronounced in 31-35 mm SL specimens first, with slightly fewer ectoparasites found in the guts of 26-30 mm and 36-40 mm SL specimens; a maximum of 16 were found in the stomach of a single spottail pinfish. Ectoparasites were absent from the stomachs of fish < 21 mm SL and > 70 mm SL. Individuals > 25 mm SL became increasingly dependent on epiphytic algae, which made up 53-87% of the food contained by large juveniles and adults. Animal material (sponges, copepods, shrimps, mysids, and small crabs, such as *Petrolisthes* sp.) was also consumed in varying amounts by fishes > 25 mm SL, but was second in importance to plant material. Other food items listed by Carr and Adams (1973) included nematodes, cyprid larvae of barnacles, polychaetes, and hydroids.

Stoner and Livingston (1984) reported six ontogenetic changes in food habits of spottail pinfish from Apalachee Bay, FL. Juveniles 11-15 mm SL consumed primarily harpacticoid copepods, invertebrate eggs, crab zoea, and other small animals; at 16-30 mm, juveniles ate a wide variety of small food items: Invertebrate eggs, harpacticoid copepods, crab zoea, and hydroids. Between 31 and 40 mm, juveniles became more omnivorous, feeding mainly on sessile organisms, such as hydroids, and macro-epiphytes. At 41-80 mm, the diet was dominated by epiphytes; polychaetes were added to the diet of 81-90 mm fish, and adults > 90 mm SL fed on epiphytes, bryozoans, mussels, and sponges.

Other authors have also reported food habits of spottail pinfish. Reid (1954), working at Cedar Key, FL, found mysids, copepods, and bryozoans in stomachs of 29-39 mm SL juveniles examined, and copepods, other crustaceans, algae, and polychaetes in 56-90 mm SL specimens. Seagrass was found in the stomach of one individual examined by Longley and Hildebrand (1941). In St. Andrew Bay, FL, Hastings (1972) reported that spottail pinfish feeding habits resembled those of sheepshead. One large adult at the St. Andrew Bay jetties had eaten numerous gastropod egg cases (probably *Thais* sp.) which it had probably scraped off rocks (Hastings 1972). Randall and Vergara R. (1978) stated that spottail pinfish feed mainly on small invertebrates, but this statement is not in agreement with the findings of Carr and Adams (1972, 1973). Small individuals (8-13 cm) were observed cleaning ectoparasites from blue runners, *Caranx crysos*, on an artificial reef off South Carolina by Parker et al. (1979). A closely related species, the silver porgy, *Diplodus argenteus*, from the West Indies feeds about 80% on algae (Randall 1967).

See 3.41.

3.43 Growth rate

Growth of spottail pinfish is rapid in the first year, with juveniles increasing about 60 mm in standard length in 6 mo (Caldwell 1955). Fastest growth occurs in early summer. Growth rate decreases in fall and is apparently near zero in winter (Caldwell 1955) (Figs. 5, 6). Specimens from Cedar Key, FL, examined by Caldwell (1955), attained approximately 80 mm SL in the first year of growth. Stoner and Livingston (1984) reported that spottail pinfish grew to about 63 mm SL by November of their first year in Apalachee Bay, and to about 119 mm SL by October of their second year.

Spottail pinfish from the South Atlantic Bight were aged by Tardiff and Manooch (footnote 4) using scale annuli. Growth was quite rapid during the first 5 yr of life, but slowed thereafter. Mean back-calculated lengths-at-ages were: I, 122; II, 176; III, 214; IV, 240; V, 258; VI, 275; VII, 292; VIII, 306; IX, 326; X, 367 (ages in years, lengths are TL in mm). Von Bertalanffy growth parameters were found to be: Mean asymptotic length (L_∞), 358 mm TL; growth coefficient (K), 0.22; and hypothetical age of zero length (t_0), −1.0 yr. The von Bertalanffy equation was:

$$L_t = 358\ (1-e^{-0.22(t+1.0)}),$$

where L_t is TL at time t, and t is age in years.

The length-weight relationship of spottail pinfish from the South Atlantic Bight (Tardiff and Manooch footnote 4) is:

$$W = 0.00001962\ TL^{2.978},$$

where W is weight in grams and TL is total length in mm (r = 0.9608, range = 125-425 mm TL).

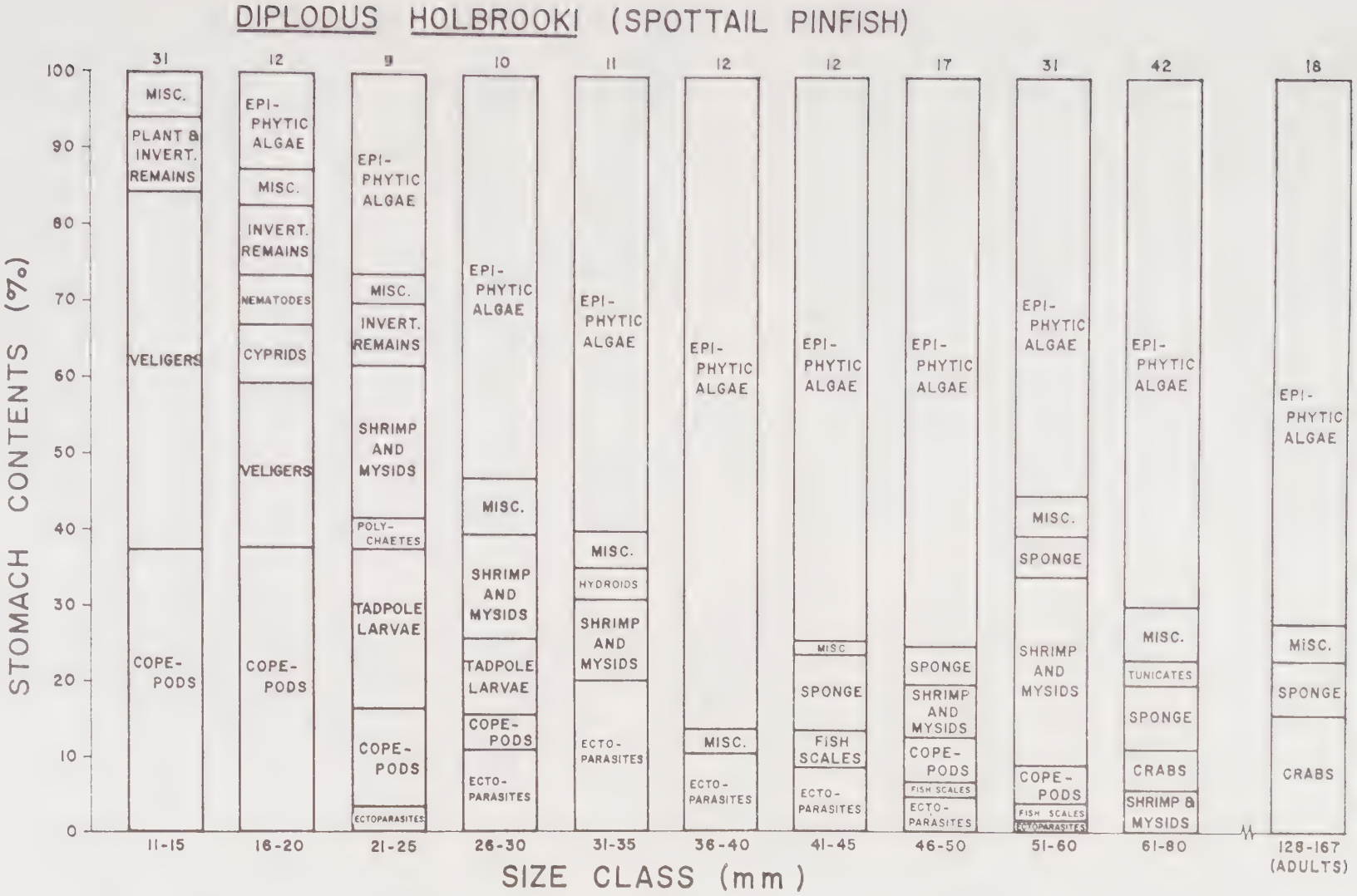

Figure 4.—Stomach contents of juvenile and adult *Diplodus holbrooki*. Bar graph for each size class (in standard length) shows percent of total stomach contents attributable to individual food items. Numbers above each bar indicate number of specimens examined. (From Carr and Adams 1973, fig. 11.)

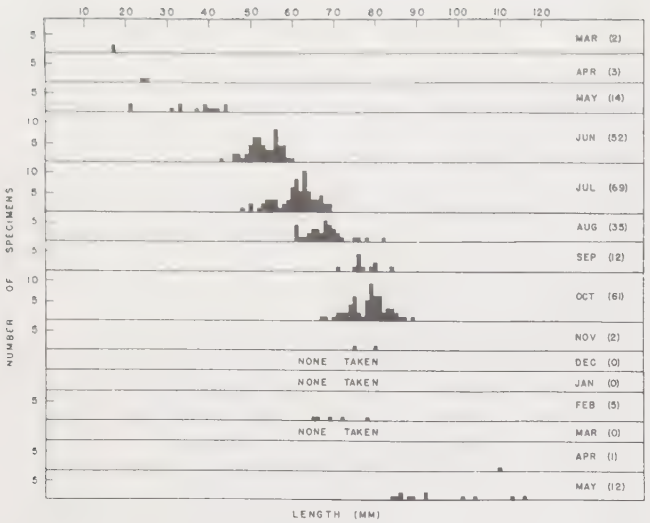

Figure 5.—Standard length frequency data for the 0 age class of *Diplodus holbrooki* at Cedar Key, FL, 1953-54. Numbers of specimens examined appear in parentheses. (From Caldwell 1955, fig. 1.)

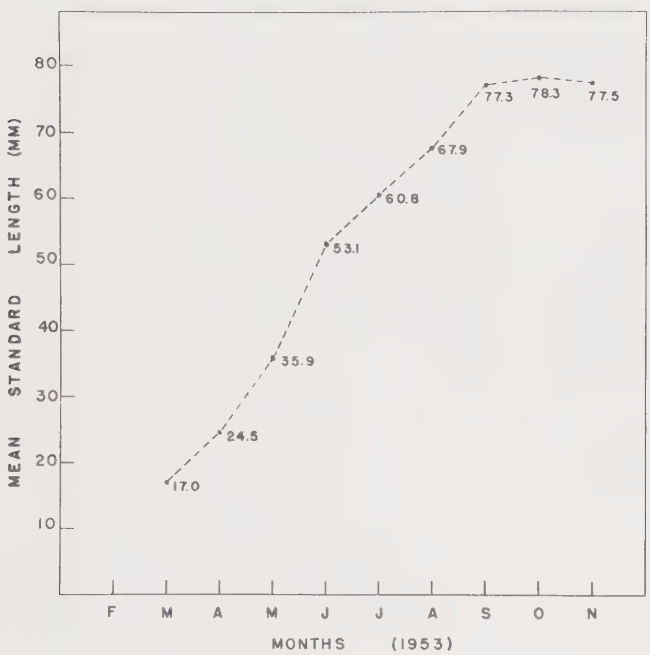

Figure 6.—Growth rate of the 0 age class of *Diplodus holbrooki* at Cedar Key, FL, during 1953. Mean standard length for each month is indicated on the curve. (From Caldwell 1955, fig. 2.)

3.5 Behavior

3.51 Migrations and local movements

Although little is known regarding movements of spottail pinfish, evidence suggests that both local movements and more extensive inshore-offshore migrations take place. Caldwell (1955) found that age-0 fish at Cedar Key, FL, moved from shallow flats, which they occupied from March to August, to deeper flats and channel edges in fall and early winter. This may have been in response to small seasonal changes in water temperature or a result of growth of the fish and different food requirements. Absence of spottail pinfish in shallow water in winter indicates that they migrate offshore to somewhat deeper water (Caldwell 1955; Smith 1976). These migrations may serve to avoid low water temperatures in shallow water. Spawning also takes place during this period.

See 2.3 and 3.16.

3.52 Schooling

Young spottail pinfish often form schools. Longley and Hildebrand (1941) reported seeing small schools along rocky shores and on a bank in the Dry Tortugas, FL. Around jetties at St. Andrew Bay, FL, large schools of 100-200 juveniles (< 8 cm SL) have been observed in May and June (Hastings 1972). Young spottail pinfish have also been reported to school heterotypically with pinfish along the southern coast of Texas (Hoese and Moore 1977).

3.52 Responses to stimuli

Spottail pinfish appear to respond to falling water temperatures in winter by moving to deeper water (Caldwell 1955; Hastings 1972).

See 2.3, 3.32, and 3.51.

4 POPULATION

4.1 Structure

4.11 Sex ratio

Sex ratio in spottail pinfish is unknown. Many sparids are hermaphrodites (Breder and Rosen 1966).

See 3.11.

4.13 Size composition

Little information is available concerning size composition of spottail pinfish. Size composition of age-0 fish from Cedar Key, FL, was reported by Caldwell (1955) (Fig. 5).

See 3.43.

4.14 Subpopulations

No subpopulations of spottail pinfish have been delineated.

4.2 Abundance and density

Spottail pinfish may be quite abundant in suitable habitats. Actual abundance is difficult to assess because catch statistics are rarely kept for this species. However, qualitative estimates have appeared in the literature, as have a few quantitative reports based on scientific surveys.

Along the southern Atlantic coast of the United States, spottail pinfish have been reported abundant at Beaufort, NC, and Charleston, SC (Goode and Gill 1903) and common at Lake Worth, FL (Jordan and Evermann 1923). Darnell and Wissing (1975) collected juveniles in shallow eelgrass beds in the Newport River estuary, NC, but reported that they were rare. Offshore, Struhsaker (1969) collected spottail pinfish commonly (10-50% frequency of occurrence) on live bottom off North and South Carolina.

In the Gulf of Mexico, spottail pinfish have been reported to be reasonably common on the west coast of Florida and offshore on the West Florida Shelf. Caldwell (1955) stated that spottail pinfish were present in moderate numbers most of the year at Cedar Key, FL. In St. Andrew Bay, FL, Hastings (1972) reported that spottail pinfish were common around jetties, increasing in abundance each year over the 3-yr study period; abundance varied seasonally and was highest in warm months. Stoner and Livingston (1984) also reported highest abundance in mid-summer in Apalachee Bay, FL. In somewhat deeper water, Smith et al. (1979) found spottail pinfish to be one of the most common fishes on artificial reefs off Clearwater, FL; they were somewhat less common on natural reefs in the area. Off Panama City, FL, spottail pinfish are moderately common around man-made platforms offshore.

On the West Florida Shelf, a benthic trawling survey in January 1978 collected spottail pinfish in 8.6% of the samples (Darcy and Gutherz 1984). Over the total area sampled from Cape San Blas, FL, to the Dry Tortugas, FL, in 9-93 m of water, spottail pinfish ranked sixth, by weight, of the total fish catch. They occurred at only one station south of Tampa Bay, and none were caught in water over 30 m deep (Figs. 7, 8). From Cape San Blas to Tampa Bay, spottail pinfish ranked fifth, by weight, of the total fish catch, comprising 6.9% of the total catch weight. The largest single catch was 1,279 individuals, weighing 89.8 kg, from a 10-min tow in 20.4 m of water.

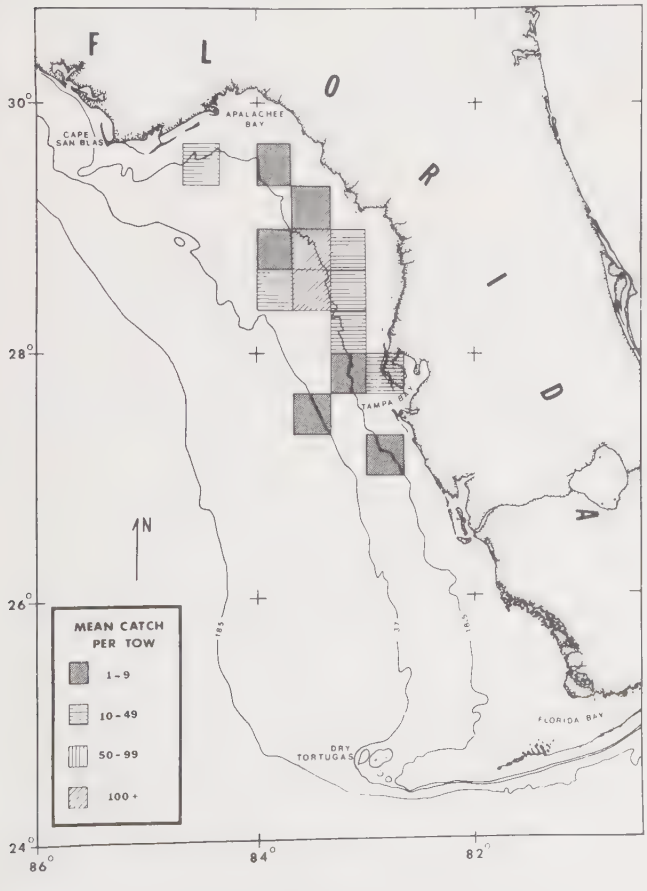

Figure 7.—Catches of *Diplodus holbrooki* from the West Florida Shelf based on RV *Oregon II* Cruise 85, January 1978. Catches are for 10-min tows of 41-ft bottom trawls.

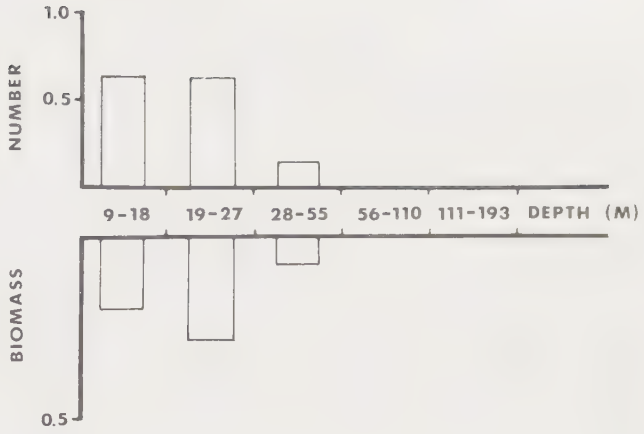

Figure 8.—Index of relative abundance of *Diplodus holbrooki* on the West Florida Shelf, January 1978. (Darcy, G. H., and E. J. Gutherz. Abundance and distribution of commonly trawled species of fishes and invertebrates, West Florida Shelf, January 1978. Manuscr. in prep. Southeast Fisheries Center, NMFS, NOAA, 75 Virginia Beach Drive, Miami, FL 33149-1099.)

Ichthyoplankton surveys in the eastern Gulf of Mexico conducted by Houde et al. (footnote 2) collected larvae of spottail pinfish on only two cruises. Based on these results, spottail pinfish larval abundance in the survey area was estimated at 1.3247-11.9585 × 10^9, and the mean number of larvae under a 10 m^2 surface area of water was estimated at 0.088-2.300.

Spottail pinfish are not common in the western Gulf of Mexico, particularly inshore (Hastings 1972). Most individuals in the western Gulf are found on offshore reefs.

See 2.1, 2.21, 2.22, and 2.3.

4.3 Natality and recruitment

4.31 Reproduction rates

The limited period of time in which larvae and small juveniles are collected indicates that spottail pinfish spawn only once a year. Fecundity is unknown.

4.32 Factors affecting reproduction

Spawning is seasonal and is probably in response to water temperature changes.

See 2.21, 2.3, and 3.16.

4.33 Recruitment

Smallest juveniles appear in shallow water in spring. Randall and Vergara R. (1978) reported that smallest juveniles (approximately 1.7 mm SL) appear in March. Smallest specimens (19 mm SL) collected by Springer and Woodburn (1960) in Tampa Bay were captured in April. At Cedar Key, FL, small juveniles (29-39 mm SL) were first collected in May (Reid 1954).

See 2.21 and 3.16.

4.6 The population in the community and the ecosystem

Spottail pinfish are important members of shallow-water grass-bed communities, and probably provide forage for larger predators. In deeper water, they are among the major reef prey

species off North and South Carolina (footnote 4). They are characteristic members of jetty fauna in the northern Gulf of Mexico, and important colonizers of new jetties (Hastings 1972). Inshore-offshore migrations may be important in energy transfer from shallow water to deeper reefs. They are also an important component of the fish fauna on offshore man-made platforms (Hastings et al. 1976) and artificial reefs (Smith et al. 1979; Parker et al. 1979) in the Gulf of Mexico and the South Atlantic Bight. Chester et al. (1984), based on catches off the Carolinas, concluded that spottail pinfish are members of an inner shelf (< 30 m) community consisting of black sea bass, *Centropristis striata*; sheepshead porgy, *Calamus penna*; whitebone porgy; longspine porgy, *Stenotomus caprinus*; and tomtate.

See 3.33, 3.34, and 3.51.

5 EXPLOITATION

5.1 Fishing equipment

Spottail pinfish are caught using hook and line, traps, seines, gill nets, and trawls (Randall and Vergara R. 1978).

5.2 Fishing areas

Spottail pinfish are caught throughout their range, usually incidentally to other fisheries (Randall and Vergara R. 1978). Because of their abundance, spottail pinfish are probably caught most often in the eastern Gulf of Mexico and on the Atlantic coast of the United States south of Cape Hatteras. The type specimen was obtained by T. Bean from a fish market in Charleston, SC (Goode and Gill 1903).

See 2.1, 2.2, and 4.2.

5.3 Fishing seasons

There is no known directed fishery for spottail pinfish, but inshore catches probably occur mainly in warmer months when they are in shallow water. Offshore catches on reefs and on trawlable bottom are probably maximum in winter when migrations take the species farther offshore.

See 2.2, 2.3, 3.51, and 4.2.

5.4 Fishing operations and results

5.41 Effort and intensity

There is no known directed fishery for spottail pinfish, and therefore no effort data.

5.43 Catches

Separate catch statistics are not reported for spottail pinfish (Randall and Vergara R. 1978). Recreational catches reported by the U.S. Department of Commerce (1980) combined spottail pinfish with several other species of sparids under the term "porgies." Hildebrand and Schroeder (1928) reported that this species was not caught in commercial quantities anywhere in its range at that time.

The flesh of spottail pinfish is of good quality (Randall and Vergara R. 1978); Jordan and Evermann (1923) reported that it is an excellent panfish. Because of its relatively small size and its availability, this species probably is used for bait, much as its close relative, the pinfish (Caldwell 1957; Hastings 1972).

6 PROTECTION AND MANAGEMENT

Spottail pinfish are not included in fishery management plans of the South Atlantic or Gulf of Mexico Regional Fishery Management Councils.

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LITERATURE CITED

BREDER, C. M., Jr., and D. E. ROSEN.
1966. Modes of reproduction in fishes. Natural History Press, Garden City, NY, 941 p.

BRIGGS, J. C.
1958. A list of Florida fishes and their distribution. Bull. Fla. State Mus., Biol. Sci. 2:223-318.

BRIGGS, J. C., H. D. HOESE, W. F. HADLEY, and R. S. JONES.
1964. Twenty-two new marine fish records for the northwestern Gulf of Mexico. Tex. J. Sci. 16:113-116.

CALDWELL, D. K.
1955. Notes on the distribution, spawning, and growth of the spottailed pinfish, *Diplodus holbrooki*. Q. J. Fla. Acad. Sci. 18:73-83.
1957. The biology of the pinfish *Lagodon rhomboides* (L.). Ph.D. Thesis, Univ. Florida, Gainesville, 171 p

CARR, W. E. S., and C. A. ADAMS.
1972. Food habits of juvenile marine fishes: Evidence of the cleaning habit in the leatherjacket, *Oligoplites saurus*, and the spottail pinfish, *Diplodus holbrooki*. Fish. Bull., U.S. 70:1111-1120.
1973. Food habits of juvenile marine fishes occupying seagrass beds in the estuarine zone near Crystal River, Florida. Trans. Am. Fish. Soc. 102:511-540.

CAUSEY, B. D.
1969. The fish fauna of Seven and One-Half Fathom Reef, northwestern Gulf of Mexico. M.S. Thesis, Texas A&I Univ., Kingsville. [Not seen.]

CHESTER, A. J., G. R. HUNTSMAN, P. A. TESTER, and C. S. MANOOCH III
1984. South Atlantic Bight reef fish communities as represented in hook-and-line catches. Bull. Mar. Sci. 34:267-279.

CHITTENDEN, M. E., Jr., and J. D. McEACHRAN.
1976. Composition, ecology, and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire Gulf. Tex. A&M Univ. Sea Grant Publ. TAMU-SG-76-208, 104 p.

DARCY, G. H., and E. J. GUTHERZ.
1984. Abundance and density of demersal fishes on the West Florida Shelf, January 1978. Bull. Mar. Sci. 34:81-105.

DARNELL, R. M., and T. E. WISSING.
1975. Nitrogen turnover and food relationships of the pinfish *Lagodon rhomboides* in a North Carolina estuary. *In* F. J. Vernberg (editor), Physiological ecology of estuarine organisms, p. 81-110. Univ. South Carolina Press, Columbia.

GOODE, G. B.
1884. The fisheries and fishery industries of the United States. Section I. Natural history of useful aquatic animals. U.S. Comm. Fish Fish., Wash., DC, 895 p.

GOODE, G. B., and T. GILL.
1903. American fishes. New ed. L. C. Page and Co., Boston, 562 p.

HASTINGS, R. W.
1972. The origin and seasonality of the fish fauna on a new jetty in the northeastern Gulf of Mexico. Ph.D. Thesis, Florida State Univ., Tallahassee, 555 p.

HASTINGS, R. W., L. H. OGREN, and M. T. MABRY.
1976. Observations on the fish fauna associated with offshore platforms in the northeastern Gulf of Mexico. Fish. Bull., U.S. 74:387-402.

HILDEBRAND, S. F., and W. C. SCHROEDER.
1928. Fishes of Chesapeake Bay. Bull. U.S. Bur. Fish. 43(part 1), 366 p.

HOESE, H. D., and R. H. MOORE.
1977. Fishes of the Gulf of Mexico, Texas, Louisiana, and adjacent waters. Texas A&M Univ. Press, College Station, 327 p.

HOLT, E. W. L.
1899. Recherches sur la reproduction des poissons osseaux, principalement dans le golfe de Marseilles. Ann. Mus. Hist. Nat. Marseilles, Zool. 5(2): 1-128.

JORDAN, D. S., and B. W. EVERMANN.
1923. American food and game fishes. Rev. ed. Doubleday and Co., Inc., N.Y.

JORDAN, D. S., and B. FESLER.
1893. A review of the sparoid fishes of America and Europe. Rep. U.S. Comm. Fish Fish., Pt. 17, 1889-91:421-544.

LONGLEY, W. H., and S. F. HILDEBRAND.
1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits, and local distribution. Pap. Tortugas Lab., Vol. 34; Carnegie Inst. Wash. Publ. 535, 331 p.

MILLER, G. C., and W. J. RICHARDS.
1980. Reef fish habitat, faunal assemblages, and factors determining distributions in the South Atlantic Bight. Proc. Gulf Caribb. Fish. Inst. 32: 114-130.

MILLER, G. L., and S. C. JORGENSON.
1973. Meristic characters of some marine fishes of the western Atlantic Ocean. Fish. Bull., U.S. 71:301-312.

MILSTEIN, C. B., and D. L. THOMAS.
1976. Fishes new or uncommon to the New Jersey coast. Chesapeake Sci. 17:198-204.

PARKER, R. O., Jr., R. B. STONE, and C. C. BUCHANAN.
1979. Artificial reefs off Murrells Inlet, South Carolina. Mar. Fish. Rev. 41(9):12-24.

RANDALL, J. E.
1967. Food habits of reef fishes of the West Indies. Stud. Trop. Oceanogr. (Miami) 5:665-847.

RANDALL, J. E., and R. VERGARA R.
1978. Sparidae. *In* W. Fischer (editor), FAO species identification sheets for fishery purposes, Western Central Atlantic (Fishing Area 31), Vol. 5, unpaginated. FAO, Rome.

REID, G. K., Jr.
1954. An ecological study of the Gulf of Mexico fishes, in the vicinity of Cedar Key, Florida. Bull. Mar. Sci. Gulf Caribb. 4:1-94.

ROBINS, C. R., R. M. BAILEY, C. E. BOND, J. R. BROOKER, E. A. LACHNER, R. N. LEA, and W. B. SCOTT.
1980. A list of common and scientific names of fishes from the United States and Canada. 4th ed. Am. Fish. Soc. Spec. Publ. 12, 174 p.

SMITH, G. B.
1976. Ecology and distribution of eastern Gulf of Mexico reef fishes. Fla. Mar. Res. Publ. 19, 78 p.

SMITH, G. B., D. A. HENSLEY, and H. H. MATHEWS.
1979. Comparative efficacy of artificial and natural Gulf of Mexico reefs as fish attractants. Fla. Mar. Res. Publ. 35, 7 p.

SPRINGER, V. G., and K. D. WOODBURN.
1960. An ecological study of the fishes of the Tampa Bay area. Fla. Dep. Nat. Resour. Mar. Res. Lab. Prof. Pap. Ser. 1, 104 p.

STEPHAN, P.
1902. A propos de l'hermaphrodisme de certains poissons. C. R. Assoc. Franc. Avanc. Sci. 30th Sess., p. 554-570.

STONER, A. W., and R. J. LIVINGSTON.
1984. Ontogenetic patterns in diet and feeding morphology in sympatric sparid fishes from seagrass meadows. Copeia 1984:174-187.

STRUHSAKER, P.
1969. Demersal fish resources: Composition, distribution, and commercial potential of the continental shelf stocks off southeastern United States. U.S. Fish Wildl. Serv., Fish. Ind. Res. 4:261-300.

U.S. DEPARTMENT OF COMMERCE.
1980. Marine recreational fishery statistics survey, Atlantic and Gulf coasts, 1979. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Curr. Fish. Stat. 8063, 139 p.

VAN OORDT, G. J.
1930. Zur mikroskopischen Anatomie der Ovariotestes von Serranus und Sargus (Teleostei). Zeitschr. Mikros. Anat. Forsch., Leipzig 19:1-17. [Not seen.]

WANG, J. C. S., and E. C. RANEY.
1971. Distribution and fluctuations in the fish fauna of the Charlotte Harbor estuary, Florida. Charlotte Harbor Estuarine Studys, Mote Mar. Lab., 56 p.

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